PSYCHE

VOL. XVIII. JUNE, 1911. No. 3.

TWO FUNGUS–GROWING ANTS FROM ARIZONA.[1]

By William Morton Wheeler.

In a recent paper on the North American fungus-growing ants [2] I based a new species of *Trachymyrmex* (*T. arizonensis*) on some male and female specimens taken by Mr. Charles Schaeffer at Palmerlee in the Huachuca Mts. of Arizona. Owing to the absence of worker specimens, the status of this species has remained somewhat problematical. At any rate, there was a possibility that it might be merely a sub-species or variety of *T. saussurei* described by Forel many years ago from Orizaba, Mexico [3] and subsequently taken as far north as Tepic by Eisen and Vaslit.[4] I was pleased therefore to find during the past November in the type locality a number of colonies of *T. arizonensis* and to be able to learn something of its habits. Both these and the characters of the worker show that the species is valid and sufficiently distinct from our other North American *Trachymyrmex* (*saussurei* Forel, *septentrionalis* McCook, *turrifex* Wheeler and *jamaicensis* Ern. André).

Somewhat later in November 1910, I came upon a few colonies of a small undescribed *Trachymyrmex* in the desert near Tucson, Arizona. Descriptions of the workers of this and of *T. arizonensis*, together with some notes on their habits are contained in the following paragraphs:

1. **Atta (Trachymyrmex) arizonensis** Wheeler (Fig. 1.)

Worker. Length 3.5–5 mm.

Head, without the mandibles, as broad as long, broader behind than in front, with feebly concave posterior and feebly convex lateral borders and bluntly angular posterior corners. Eyes hemispherical, in front of the middle of the head. Mandibles with two large apical and numerous smaller basal teeth. Clypeus flattened, its anterior border slightly reflected and in the middle sinuately excised. Frontal area triangular, rather indistinct. Frontal carinæ large, with rounded external borders, their surface scarcely concave in the middle, continued behind as a pair of straight, diverging ridges to the posterior corners of the head. Vertex with two shorter, parallel ridges. There is also a short oblique ridge running mesially along each inner orbit half way to the ridge continued back from the frontal carina. Antennæ long; scapes reaching somewhat more than ⅓ their length beyond the posterior corners of the head, slender at the base, thickened distally and again more attenuate at the apex. Pronotum with a slender, lapped-shaped inferior and a stout, pointed superior spine on each side, without an anteromedian paired or unpaired tubercle. Mesonotum on each side in front with a stout, blunt protuberance and behind with three small protuberances, two of which are hardly more than tubercles. Mesoëpinotal constriction pronounced. Epinotum with subequal

---

[1] Contributions from the Entomological Laboratory of the Bussey Institution, Harvard University. No. 37.

[2] The Fungus-Growing Ants of North America. Bull. Amer. Mus. Nat. Hist. XXIII, 1907, pp. 669–807, 5 pls. 31 text-figs.

[3] Études Myrmécologiques en 1884, Bull. Soc. Vaud. Sci. Nat. XX, 91, 1884, pp. 1–65, 1 pl.

[4] See Pergande, Mexican Formicidæ. Proc. Cala. Acad. Nat. Sci. 3 ser. Vol. V, 1895, p. 896.

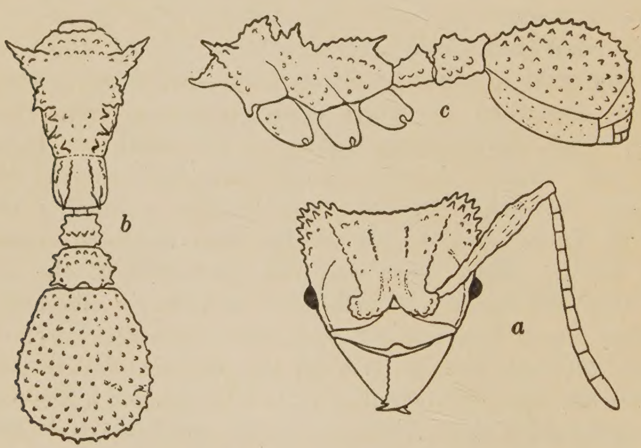

Fig. 1. *Trachymyrmex arizonensis* Wheeler. Worker; *a*, head; *b*, thorax and abdomen seen from above; *c*, same seen in profile.

base and declivity, the latter sloping, the former flattened and bearing a pair of longitudinal ridges which diverge slightly behind and terminate in the spines. These are acute and rather slender, a little longer than broad at their bases, directed outward and backward and but very slightly upward. Petiole with a narrow and very short peduncle; its node with a bitubercular summit, seen from above as long as broad, rounded behind, with parallel sides; in profile it is acutely angular, with straight anterior and posterior declivities, the former a little longer than the latter. Postpetiole nearly twice as broad as the petiole, broader behind than in front; its posterior border with a rounded lobe on each side and a rounded excision in the middle. Its upper surface is distinctly concave behind, so that in profile it is highest in front, with a short, straight anterior and a somewhat longer, concave posterior slope. Gaster oval, slightly broadest behind the middle, its first segment with only a trace of a median longitudinal impression at the anterior end. Legs long and rather slender.

Mandibles and clypeal border shining, the former finely striated. Remainder of body opaque and finely granular or very finely punctate-rugulose. The various ridges, spines and protuberances, the front, the posterior corners and occiput of the head, the thoracic dorsum and pleuræ (except in the mid-dorsal line between the protuberances), the upper-surface of the petiole, post-petiole (except its concave dorsal surface), and gaster beset with small but prominent and rather acute tubercles. Legs, scapes and cheeks beset with similar but smaller and much less prominent elevations.

Hairs and pubescence fulvous, the former hooked, erect and rather uniformly distributed over the body, legs and scapes; the pubescence is very short and delicate and present only on the antennal scapes.

Body ferruginous red; legs and antennæ a shade paler; borders of mandibles black; frontal area, vertex and occiput each often with a black or dark brown spot. Old specimens not infrequently have the body covered with a bluish bloom.

Described from numerous specimens taken Nov. 10–16, 1910 from several colonies in Miller and Hunter Canyons, Huachuca Mts., Arizona at elevations varying from 5000 to 6000 ft.

T. arizonensis is most closely related to *T. saussurei* Forel but differs from this species and from *T. septentrionalis* in its larger average size, much deeper color, longer antennal scapes, more numerous and more acute tubercles, especially on the posterior portions of the head and upper surface of the gaster, the less rounded sides of the head, the stouter and more backwardly directed epinotal spines and the erect, instead of reclinate, hairs on the legs and antennal scapes. From *T. turrifex*, *arizonensis* differs in its much larger size, much longer antennal scapes, more backwardly directed epinotal spines and proportionally narrower postpetiole. In *turrifex*, moreover, the mesoëpinotal constriction is more pronounced, the epinotal declivity is not sloping but vertical, the inferior pronotal spines are acute, there is a prominent median pronotal tubercle and the dorsal surface of the postpetiole is beset posteriorly with small tubercles and is flattened but not concave.

The territory in which *T. arizonensis* was observed would seem at first sight to be very unfavorable to an ant addicted to cultivating fungi for food, and is certainly very different from that inhabited by *T. septentrionalis* and *turrifex*. *T. septentrionalis* flourishes only in the sandy oak woods of the Mississippi Valley, Atlantic and Gulf States as far north as southern Illinois and southern New Jersey; while *T. turrifex* prefers the black or argillaceous soil of the cedar brakes and post-oak woods of central Texas. Both are essentially lowland species. *T. arizonensis*, however, lives in the arid, stony mountain canyons of southern Arizona and undoubtedly also in similar localities in northern Mexico. In the Huachucas the nests were never seen on ridges or elevations but invariably on the slopes or in the very beds of the small dry arroyos entering from the north the main canyons which run from west to east. These situations are evidently selected because of their greater exposure to the southern sun and the longer retention of moisture in their soil.

The nests can be easily recognized by the portions of exhausted fungus gardens scattered about their main entrances. This refuse is usually of a bright yellow color and quickly arrests the eye of one who is scrutinizing the soil for signs of ants. The largest *arizonensis* nest seen was situated in front of Mr. Joseph Palmerlee's ranch in Miller Canyon at an altitude of 5500 ft. It was in such hard, stony soil that I was unable to reach its lowermost galleries even when Mr. Palmerlee came to my assistance with a large pick and a pair of powerful arms. The nest had three entrances, one on a rude crater sprinkled with yellow fungus-garden refuse and two others about 10–14 inches from the crater opening and about a foot apart at the edge of a boulder some three feet in diameter. On removing this the two openings were seen to lead into converging galleries $\frac{1}{2}$ to $\frac{3}{4}$ of an inch in diameter, which ran along the surface of the soil for several inches, and then united and descended perpendicularly as an irregular passage-way between a couple of large stones to a depth of two feet. Here it joined an obliquely ascending gallery which was traced to the opening on the crater, and the common gallery thus formed at once opened into a chamber 10 inches long by 6 inches in diameter and only 2–3 inches high, the roof of which was formed by the lower surface of one of the two large stones. Although this chamber was apparently a natural cavity and had not been excavated by the ants, it nevertheless contained a large fungus-garden which was suspended from the lower surface of the stone and hung in folds like a series of curtains. In this respect and also in its bluish white color it resembled very closely the gardens of *T. septentrionalis* and *jamaicensis* which I described in my former paper (*loco citato* pp. 750 and 760). From the floor of the chamber a vertical gallery descended into the soil but was followed only a few inches to where it passed under a boulder that could have been removed only with a charge of dynamite. The soil about the nest was so hard that it had been soaked by a recent heavy rain only to a depth of eighteen inches and the walls of the fungus chamber were very dry and dusty.

The colony inhabiting this nest was very large, comprising several hundred workers and being fully four to six times as populous as the largest *septentrionalis* and *turrifex* colonies I have seen. The workers were also more rapid in their movements and feigned death much less readily than our other species of *Trachymyrmex*. The colony was evidently in a hibernating or subdormant condition and contained neither larvæ nor pupæ. I also failed to find any deälated queens, but these may have escaped into the lowermost galleries as soon as the surface boulder was removed. The breeding season of the species probably does not begin till just after the rains in early July. This is indicated by the late appearance of the males and winged females which were taken, evidently while on their nuptial flight, by Schaeffer, on August 24.

All the other colonies of *T. arizonensis* found in the Huachuca Mts. were examined less thoroughly, but all had essentially the same structure at the surface of the soil. The entrances, usually only one or two in number, were always near or just under the edge of some large stone and when this was removed the galleries could be followed along the surface for several inches before they descended to a lower level. In two instances portions of the surface galleries were packed with fungus-garden refuse in a manner that recalled the conditions I have described for *Cyphomyrmex wheeleri* (*loco citato* p. 768). Unfortunately I was unable to reach any of the chambers in these nests and was therefore unable to determine whether the size and conditions described for the single nest excavated with the aid of Mr. Palmerlee, were normal. I believe, however, judging from the character of the soil in which these ants live, that the chambers are commonly under stones and that the fungus-gardens are suspended from the under surfaces of these and not from rootlets as in the other species of *Trachymrmex* that have been studied.

On warm days the *arizonensis* workers may be seen about the entrances of their nests. They go forth timidly and singly like other species of *Trachymyrmex*, not in populous files like the species of *Atta sens. stricto*, *Acromyrmex* and *Mœllerius*, and bring in caterpillar excrement and bits of green and withered vegetable débris with which to replenish the substratum of their gardens. Microscopic examination of these shows that they have essentially the same minute structure as those cultivated by other species of *Atta*. The brown, triturated substratum is enveloped and shot through with a delicate, ramifying mycelium on which numerous glistening white clusters of food-bodies are formed as pyriform swellings at the ends of the hyphæ. In my former paper I employed the name "bromatia" for the clusters ("Kohlrabihäufchen" of Moeller) and that of "gongylidia" for the hyphal swellings ("Kohlrabiköpfchen" of Moeller), but Neger[1] has recently suggested that the term "ambrosia" be given to the hyphal modifications produced and eaten by all fungus-growing insects, *i. e.*, by the ants and termites as well as by the Ipid (Scolytid) beetles for which the term "ambrosia" was originally suggested by Schmidberger as long ago as 1836. I am quite willing to accept this term and to abandon my own nomenclature.

The only insects that could be suspected of myrmecophily in connection with *T. arizonensis* were a number of small, yellow, wingless, cockroaches which I found in the superficial galleries of a nest in Hunter Canyon. These cockroaches, however, were not species of the genus *Attaphila*, which Berg and I have taken from the nests of the large species of *Atta*, but were probably merely the young of some much less remarkable cockroach and were behaving as scavengers. The same species was also found in the upper galleries of several other ants in the same locality, especially in nests of *Odontomachus clarus*.

2. **Atta (Trachymyrmex) desertorum** sp. nov. (Fig. 2).

Worker. Length 2.5–3.5 mm.

Head, without the mandibles, as broad as long, slightly narrower in front than behind, with feebly convex lateral and straight or nearly straight posterior border and angularly rounded posterior corners. Eyes hemispherical, in front of the middle of the head. Mandibles with two larger apical and several minute basal teeth. Clypeus flattened, with its anterior border sinuately reflected. Frontal area triangular, rather distinct. Frontal carinæ with angular external borders and flattened but not concave surfaces; continued back as a pair of diverging ridges to the posterior corners of the head. Vertex without a pair of short ridges, but each of the inner orbits with a distinct ridge which runs obliquely and mesially and stops half way between the eye and the ridge from the frontal carina of the same side. Antennal scapes somewhat thickened just beyond the middle, reaching a little less than ⅓ their length beyond the posterior corners of the head. Thorax in profile with deep mesoëpinotal constriction; pro- and mesonotum convex; epinotum with subequal base and declivity, the former slightly convex, the latter sloping and concave Inferior pronontal spines prominent, with blunt tips; superior spines reduced to angular projections, between which there is a pair of small blunt median protuberances. Mesonotum on each side with two angular projections which are as large as the superior pronotal pair and of similar size and shape. Extreme posterior portion of mesonotum with a small blunt projection just in front of the mesoëpinotal constriction. Base of epinotum with four longitudinal ridges, the inner pair of which is the more prominent, diverges somewhat posteriorly and terminates in the spines, which are acute, a little longer than broad at their bases and directed upward, backward and slightly outward. Petiole with a very short, narrow peduncle; its node seen from above as long as broad, rectangular, with four longitudinal ridges; in profile the node is pointed above, with subequal anterior and posterior slopes, the former concave, the latter straight. Postpetiole twice as broad as the petiole, nearly as long as broad, broadest just behind the middle; its posterior border excised in the middle, with a rounded lobe on each side; dorsal surface somewhat impressed behind, so that in profile the upper surface is convex and rounded in front and concave posteriorly. Gaster suboblong, broadest behind the middle, with straight sides in front and without any trace of a median dorsal furrow. Legs moderately long and stout.

---

[1] Ambrosiapilze. Ber. Deutsch. Bot. Gesell. 1908, Bd. XXVI. Heft 10, pp. 735–754, 1 pl.

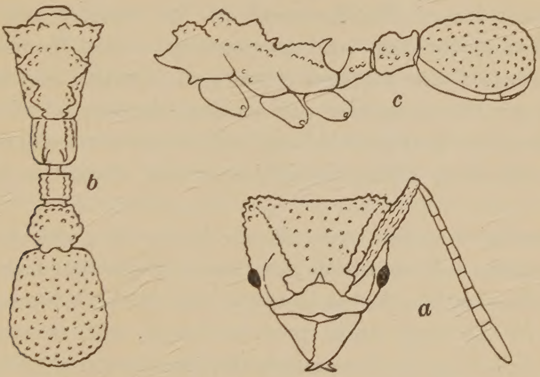

Fig. 2. *Trachymyrmex desertorum* sp. nov. Worker; *a*, head; *b*, thorax and abdomen seen from above; *c*, same seen in profile.

Mandibles longitudinally striated, at least their apical portions and the border of the clypeus shining; remainder of body opaque, finely granular, except the legs which are very faintly shining. The various ridges and projections on the head, thorax and petiole, as well as the vertex, occiput and posterior corners of the head and the upper surface of the gaster beset with small, rather blunt tubercles. These are largest on the posterior corners of the head. Antennal scapes and legs covered with smaller and much less distinct tubercles.

Hairs and pubescence fulvous, the former hooked, uniformly distributed over the body, scapes and legs, suberect on the body, scapes and legs, more reclinate on the legs. Pubescence very short and delicate, confined to the antennal funiculi.

Body ferruginous red; mandibles, antennæ and legs somewhat paler; clypeus darker, mandibular teeth, frontal area and a longitudinal mid-dorsal streak on the gaster, black.

Described from nine specimens taken Nov. 24, 1910 a few hundred yards from the Carnegie Desert Botanical Laboratory near Tucson, Arizona.

This species is readily distinguished from all our other North American species of *Trachymrmex* by its smaller size and the conformation of the pro- and mesonotum. Seen from above this region presents three successive pairs of bluntly angular projections of much the same size and shape, whereas in all our other forms at least the first pair is long, rather slender and pointed and differs considerably either in shape or size from the succeeding pairs.

T. desertorum was first seen on the banks of a dry arroyo that skirts the rocky hill on which the Desert Botanical Laboratory is situated. Here in the feeble shade of the *Parkinsonia* and *Acacia* trees and in the very hard, pebbly, desert soil, two nests were located by following single workers that were returning home laden with caterpillar excrement or with green or yellow *Acacia* leaflets. These nests were so inconspicuous that they could not have been found in any other way, for the entrance to each was merely a circular opening only 1/16 of an inch in diameter among the pebbles, with a few dead leaves forming a small and very indistinct crater around it. The entrance gallery descended perpendicularly into the soil. As I did not discover the ants till late in the afternoon and was obliged to leave Tucson the following morning, I was unable to excavate the nests. These are probably similar in structure to those of *T. turrifex* which I have described in detail in my paper on the North American Attii (*loco citato* p. 753).

T. desertorum is one of three fungus-growing ants I have found in the dry arroyo near the Desert Botanical Laboratory. As these insects will be within very convenient reach of the botanist who may care to study the interesting fungi which they grow and eat, I may add a few remarks on the two species which occur with *T. desertorum.* These are *Atta* (*Mœllerius*) *versicolor* Pergande and *Cyphomyrmex rimosus* Spinola. The former is very common and conspicuous not only in the open deserts about Tucson, but also at Yuma, Yucca and Benson, where I took it during the past autumn and in Garden Canyon in the Huachuca Mts., where it has been taken by Mr. W. M. Mann. Its workers are polymorphic and those of the smallest caste are in size and coloration so much like *Trachymyrmex desertorum* that this ant is very easily overlooked even when one is scrutinizing the surface of the soil with the closest attention. *Cyphomyrmex rimosus*, which, as I have shown (*loco citato* p. 771), grows a very peculiar fungus on moist caterpillar excrement, nests in the shade of trees and bushes, and although I have taken a few specimens along the banks of the dry arroyo near the Desert Laboratory, I have found the species more abundant on the damp walls of the irrigating ditches along the Santa Cruz River between the laboratory and the city of Tucson. Since *C. rimosus* is a very small ant, colored much like the soil and quickly stops running or curls up and feigns death when the soil in its vicinity is jarred, it readily escapes observation. Fortunately its nests are shallow and its remarkable fungus-gardens, so unlike those of the various species of *Atta*, *Mycetosoritis*, etc., are easily unearthed and examined after they have once been located by following homing workers.

ON SOME NORTHWESTERN ANTS AND THEIR GUESTS.

By William M. Mann,
Stanford University, California.

These notes are based on a collection of ants and myrmecophiles made by the writer in Washington and Idaho, during 1908–1909, while a student at the State College of Washington, at Pullman. Some collecting had been done previously at Helena, Montana, and six weeks were spent at the Puget Sound Marine Laboratory on Orcas and San Juan Islands, Puget Sound, where considerable collecting was done.

I am under obligations to Prof. William M. Wheeler of Harvard University, for determining my ants, and to Prof. A. L. Melander, through whom I was given opportunities to visit and collect in a number of localities. This paper was prepared in the Entomological laboratory of Stanford University.

In collecting little sifting was done, but traps were used wherever practicable. A piece of board or a flat stone buried in a mound proved a good means to attract inquilines.

Solenopsis molesta Say.—Common in vicinity of Pullman and Wawawai, Wash.

Pheidole oregonica Emery.—Common at Pullman and Wawawai, Wash. At the latter place, four specimens of *Cremastochilus knochii* were found in a nest. A great many other nests were examined, but no inquilinous beetles were found.

Aphaenogaster subterranea Latr. subsp. **occidentalis** Emery.—Many nests examined at Pullman and Wawawai, Wash. During April and the early part of May the Pselaphid *Ctenestes pulvereus* Lec. was taken commonly, nearly every nest containing one or two. April 10, Prof. A. L. Melander took a number of specimens of an undescribed *Batrisus* with this ant at Kendrick, Idaho. Several nests were examined and all contained the beetles. A single spcimen of *C. pulvereus* was found here also.

Pogonomyrmex occidentalis Cress.—Occurs commonly in the Snake River Canyon at Wawawai, and at Lewiston, Idaho.

Myrmica rubra L. subsp. **brevinodis** Emery.—Taken at Helena, Montana.

Myrmica scabrinodis Nyl. var. **sabuleti** Meinert.—A nest on San Juan Island, Puget Sound.

Leptothorax curvispinosus Mayr subsp. **rugatulus** Emery. Taken at Helena, Montana.

Tapinoma sessile Say.—Common throughout Washington. A large number of nests were examined and no myrmecophiles found. But in the vicinity of Ellensburg, Wash. (March 12, 1909) the tiny cricket, *Myrmecophila oregonensis* occurred in every nest examined.

On Orcas Island, Puget Sound, nests of the pale variety of this ant were often exposed in lifting the bark from fallen trees, and in one nest there were three specimens of a Staphylinid, determined by Dr. A. Fenyes as *Zyras (Myrmœcia) lugubris* Casey. This beetle, when the nest is uncovered, runs about among the ants, with the tip of the abdomen raised. Wasmann has placed the European *Myrmœcia fussi*, also commensal with *Tapinoma*, as a synechthran, and it has been observed to eat the ants. I have not examined the other species, but in *lugubris*, on the dorsum of the penultimate segment of the abdomen, are typical golden trichomes, characteristic of symphiles. So if *lugubris* does feed on the ants, here is a case of a predaceous insect with adaptations toward making itself tolerated by its intended prey, an example even more extreme than *Xenodusa*, which confines its attacks to the larvæ of the ants.

Iridomyrmex analis André.—At Wawawai, Wash. Rare.

Lasius niger L. var. **neoniger** Emery.—Abundant in the vicinity of Pullman, where numerous nests were examined. Myrmecophiles were taken on two occasions only. May 13th a single specimen of *Hetærius tristriatus* Horn was found among a thick cluster of ants on the under side of a stone, and two specimens of the blind *Adranes taylori* Wick. were taken on the same date, from another nest.

Lasius niger L. var. **americanus** Emery.—*Adranes taylori* was taken in numbers with this ant at Troy, Idaho, in May. The nests were first visited in the afternoon and the beetles found in the upper galleries of every nest examined. No other myrmecophiles were found in these nests, but in July on San Juan and Orcas Islands, Puget Sound, *Myrmecophila formicarum* was abundant.

Lasius brevicornis Emery.—A single nest found at Pullman, Wash.

Lasius (*Acanthomyops*) **interjectus** Mayr. Common near Pullman. Many nests were examined, some of them repeatedly. The only guests were a pair of *Adranes taylori*, taken March 22.

Lasius (*Acanthomyops*) **latipes.**—One nest, found under a stone on the banks of the Snake River, at Wawawai, contained eleven specimens of *Adranes taylori* and one of *Triballus californicus.* Though the latter beetle is often found in ant nests, it is as frequently found away from them, and is doubtfully commensal.

Formica sanguinea subsp. **subintegra** Emery, and **Formica subpolita** var. **picea** Emery.—A mixed colony found under a stone in the vicinity of Pullman, Wash.

Formica sanguinea subsp. **subnuda** Emery, and **Formica dakotensis** Emery.—Mixed colonies abundant at Troy, Idaho, in May and June, nesting in rotten logs and stumps.

Formica rufa subsp. **obscuripes** Forel.—This, the common mound-building ant of the Northwestern states, is the most conspicuous ant in eastern Washington. Several large colonies, located on the campus of the State College, were regularly examined throughout the spring. March 1, I took with this ant a single specimen of *Platymedon laticollis* Casey. This brightly colored little staphylinid was later found common in most of the mounds examined, and may be considered as the characteristic inquiline of that ant in Eastern Washington. It was found in all parts of the nests, generally where the ants were thickest and in no instance did I observe the ants to molest or even notice it.

The most interesting find with *obscuripes* was a species of *Aphodius.* Three specimens were taken on March 5 from a populous nest, which had been previously baited with a piece of board. Although the allied genus *Euparia* is an ant guest, no *Aphodius* has been recorded as myrmecophilous, so the occurrence of these three specimens was thought accidental. The board was carefully examined and replaced on the nest. The next day another of the beetles was taken, and specimens continued to turn up until March 18. In all eight were taken from the one nest.

The finding of this species, belonging to a genus normally coprophagous in habit, in an ant nest may seem too slight an evidence for considering it myrmecophilous, but the repeated occurrence during a period of over two weeks' time may have some significance. The beetle is apparently new, and I am describing it as *Aphodius suspectus* sp. nov.

Toward the middle of March, larvæ of Microdon were very numerous in the nests. These pupated in the early part of April, and I collected a number to rear. The first adult emerged April 20, and others from then until the middle of May. The species is evidently a variety of *Microdon tristis* Loew.

One specimen of *Cremastochilus pilosicollis* was taken on March 26, and two more were found in April. Toward the middle of May they became abundant, twenty-eight being taken from one nest. When the nests were uncovered *pilosicollis* would be seized by the legs and thoracic angles by numbers of ants. In two instances ants retained their grip even after death in the alcohol bottle. Larvae of *pilosicollis* were often exposed, but the ants did not attack them. I have examined a series of fifty adults from the nest of *obscuripes* and failed to find a single mutilated specimen, so this ant must be much more tolerant of *Cremastochilus* than *Pogonomyrmex*, or even *Camponotus*, with which mutilated beetles of this genus are often found. This is surprising, for to judge from the ordinary behavior of *obscuripes*, tolerance is the last quality to be expected.

One specimen of a small scavenger beetle, *Tachyporus californicus*, was in one nest, and in another a single *Cremastochilus knochii*. A spider, kindly determined for me by Mr. Banks as *Tmeticus perplexus* Keyes, was very often found, generally deep in the nest. It may feed on the very young ant larvæ. Large spiders, most commonly Thomisidæ, are not uncommon on the outskirts of nests of other ant species. They are very often seen holding dead ants, so their proximity to the nest is easily explained.

Formica rufa subsp. **integra** var. near **coloradensis** Wheeler. A number of specimens were sent to me from Medford, Oregon, by Mr. C. M. Keyes, and with them a number of *Coscinoptera* cases. No adults emerged from these.

Formica rufa subsp. near **integra** Nyl.—Several nests examined on San Juan Island. *Myrmecophila formicarum* abundant.

Formica fusca var. **argentata** Wheeler.—Common in vicinity of Pullman, either in independent nests or as slaves of *Polyergus rufescens* subsp. *breviceps* Emery. A mixed nest examined March

5 contained one *Hetærius tristriatus*, and one *Hister subopacus*. Another contained one *H. tristriatus*. A third nest, a flourishing one, was under observation from March 24 to June 1, during which time six *Cremastochilus knochii*, one *C. pilosicollis*, seven *Hetærius tristriatus*, and six specimens of an undescribed species of *Hetærius*, were taken. All of these myrmecophiles and also *Myrmecophila manni* Schimmer, were taken with independent colonies of *argentata* at Pullman and at Wawawai. The new *Hetærius* I am describing as *H. exiguus* sp. nov.

Formica fusca var. between **neoclara** and **argentata.**—Common at Wawawai, Wash., where, during March, every nest sheltered numerous inquilines—*Hetærius tristriatus, Cremastochilus knochii, Myrmecophila manni.*

Formica fusca var. **subaenescens** Emery.—One *Cremastochilus knochii*, San Juan Island, Wash., July, 1910.

Formica fusca var. **neorufibarbis** Emery.—San Juan Island, Wash., *Myrmecophila formicarum* Scudder was abundant.

Formica fusca.—Three undescribed varieties on San Juan Island, in July. *Myrmecophila formicarum* occurred in all, and with one, two specimens of *Cremastochilus pilosicollis* were taken, one of them by Prof. McConnell, of the Pennsylvania State College.

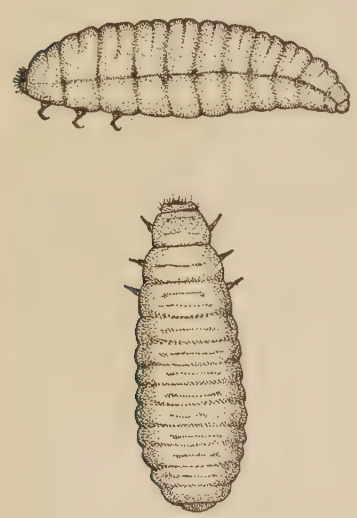

Fig. 1. Coleopterona larva, probably a Coccinellid, taken with *Formica camponoticeps*.

Formica subpolita var. **neogagates** Emery.—Very common in vicinity of Pullman. *Cremastochilus knochii* occurred in nearly every nest during March. *Myrmecophila manni* was found, but rarely.

Formica manni Wheeler.—Nests found at Wawawai, Pullman, Wapota, Kiona, and Wenatchee, Wash. This seems to be the characteristic *Formica* of the upper Sonoran zone in Washington, and it occurs also in the Transition zone at Pullman. A single specimen each of *Hetærius tristriatus* and *Cremastochilus knochii* were taken with this ant at Wenatchee.

Formica camponoticeps Wheeler.—The only nest found was under a flat stone at Wawawai, March 28, 1909. In the nest were two remarkable, soft-bodied Coleopterous larvæ, which I have been unable to determine definitely, though they are probably Coccinellidæ. These larvæ (fig. 1) were in the runways of the nests. In life they were covered densely with a white powder, and some of this remains after an immersion of two years in alcohol. The alcoholic specimens are 6–7 mm. in length; 2.5 mm. greatest width, 2.25 mm. at greatest height.

Componotus maculatus subsp. **vicinus** Mayr.—One specimen of *Xenodusa montana*, (?) Casey, taken at Helena, Montana, April 16, 1907.

Camponotus herculeanus subsp. **pennsylvanicus** De Geer. *Myrmecophila formicarum* was abundant with this ant on San Juan Island, Wash., in July.

Camponotus maccooki Forel.—Mr. C. M. Keyes sent me this species from Medford, Oregon, and with it several specimens of *Myrmecophila formicarum*.

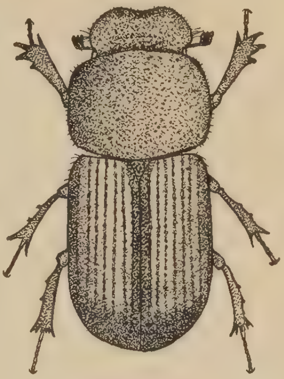

Fig. 2. *Aphodius suspectus* sp. nov.

Aphodius suspectus sp. nov.

Length 4 to 5 mm., oblong black, shining. Head coarsely punctate, some of the punctures on the front confluent; a narrow transverse impunctate ridge, extending transversely across the head at about one third distance from base; in front of this ridge depressed, then elevated to a low flat tubercle; depressed between this and margin; margined for entire length, margin with row of fine hairs, which end in front of eyes in a brush of longer hairs; front with a few fine, short hairs; clypeus shallowly emarginate. Prothorax broader than long, feebly narrowed behind, at base slightly wider than elytra; sides moderately margined; base with feeble marginal line; sides slightly convex, disc shining, convex, strongly punctate, the punctures arranged unevenly, and varying in size; a longitudinal impunctate line at middle of disc, running entire length of disc; margin with a row of short even hairs; a few fine scattered hairs on disc.

Elytra brownish, $1\frac{2}{3}$ as long as prothorax, brownish yellow, apex brown; suture and margin sometimes brown; sides nearly straight for one half distances from base, then gradually rounded to apex; striæ, moderately impressed, the outer three becoming confluent before apex; each stria with row of punctures; fine scattered hairs on elytra.

Body beneath black, everywhere with fine hairs; mesosternum posterior to coxæ finely granular; disc of metasternum flat, shining, with few punctures; sides of metasternum divided into two triangular areas, the outer, anterior part opaque and strongly punctate, the posterior part smooth and shining.

Legs dark brown to black, tarsi reddish brown.

Described from eight specimens from nest of *Formica rufa* subsp. *obscuripes*, Pullman, Wash.

The width of the sutural stripe is variable. In two of the specimens before me the punctures of the striæ are larger and brown, and the striæ appear as brown stripes. There is a perfect gradation from this to the totally unstriped form. Structurally this species can be assigned to none of Horn's groups of the genus.

I have placed paratypes of *A. suspectus* in the collections of H. C. Fall, H. F. Wickham, and E. C. Van Dyke.

Hetaerius exiguus sp. nov.

Shining, color light reddish to dark brown; form rather elongate. Head above very faintly punctured, with few hairs; clypeus with stronger punctures; front slightly concave.

Prothorax transverse; sides straight, convergent from base to oblique truncation of outer angle; disc very minutely punctured; punctures without evident hairs; no evident hairs on prothorax except short brush at margin; lateral portion not more noticeably punctate than the disc, separated from rest of disc by shallow groove, which terminates in depression at anterior and at posterior margin: divided at basal third by shallow, oblique impression, the posterior portion slightly convex, slightly elevated.

Elytra at base a little wider than prothorax, marginal striæ complete, discal striæ nearly attaining the apex of the elytra, hairs few, short and fine, stronger at margins and toward apex, most of the disc not noticeably hairy. Prosternum margined for five eighths of the distance from base, the margined posterior of disc impunctate and shining, anterior part coarsely punctured.

Anterior femora about two sevenths as wide as long.

Eleven specimens taken at Pullman, Wash., during April and May 1910, with *Formica sanguinea* var. *argentata* Wheeler, either in independent nests or with *Polyergus*. One specimen, April 4 at Kendrick, Idaho, with the same species of ant. One at Kendrick, Idaho, April 1, with *Stenamma* (*Aphœnogaster*) *subterranea var. occidentalis*. This is the least hairy and most elongate of the known American species. It appears to be nearest to *H. minimus* Fall, from which it differs in the inconspicuous punctation and pubescence, the narrow femora and more concave front. In these characters it approaches *H. brunneipennis.* It can be separated from this species by the smaller size, more elongate body and total absence of long yellow hairs. In *brunneipennis* the margin of the pronotum is more noticeably punctured than the disc, while in *minimus* and *exiguus* there is no appreciable difference.

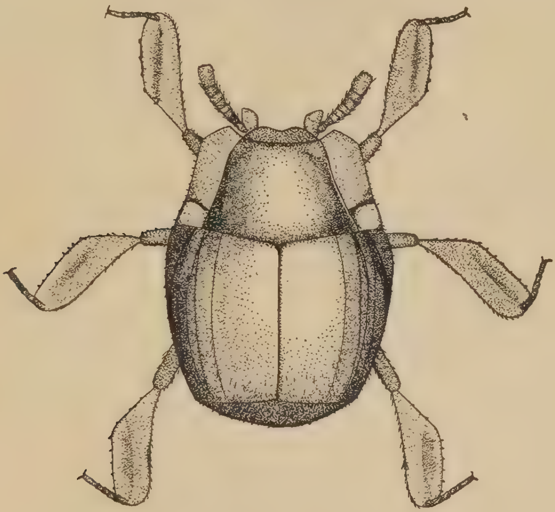

Fig. 3. *Hatœrius exiguus* sp. nov.

In the same specimens the elytral hairs are more noticeable and can be seen the entire length of the striæ, becoming stronger posteriorly. There exists a wider variation in color than is common in the genus. The elytra and pronotum are seen to be irregularly punctate.

A NEW SLAVE-MAKING ANT FROM JAPAN.

By M. Yano,

Imperial Forestry Experiment Station, Tokyo, Japan.

One of the most interesting Japanese ants in my collections is a slave-making species, belonging to *Polyergus*, and apparently distinct from the known European and North American forms of the genus.

Polyergus rufescens Latreille subsp. **samurai** subsp. nov.

Worker. Length 5–6 mm.

Head nearly pentagonal, excluding mandibles; with somewhat parallel sides, prominent occipital portion and nearly straight posterior border; the mandibles narrow and long, curved inward, pointed, with a minutely dentate masticatory margin, clypeus triangular, broad, and flat, its anterior margin nearly straight; frontal area small, distinctly broader than long, its posterior suture rounded, anterior suture nearly straight; median line long and distinct; antennal carinæ not distinct; antennæ rather short, the scapes just reaching to the posterior border of the head, somewhat swollen apically, the flagellum long, filiform; ocelli very distinct;

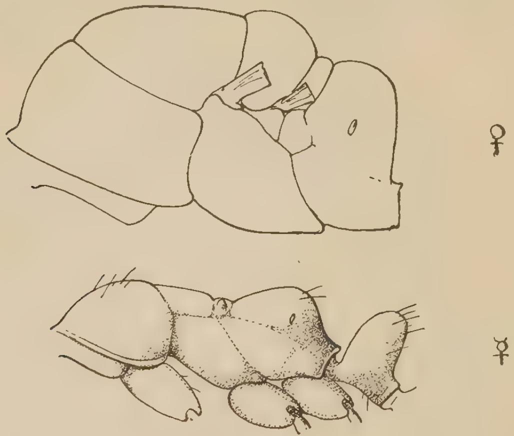

Fig. 1. *Polyergus rufescens* Latr., subsp. *samurai* subsp. nov. Profile of thorax in female and worker.

eyes prominent. Thorax a little narrower than the head; pronotum rounded above and in front; mesonotum longer than broad, flat above; pro-mesonotal suture distinct, with a lateral distinct suture between the mesonotum and mesopleuræ; meso-metanotal depression very wide; epinotum a little narrower than the pronotum, much produced, rather sharply rectangular between the basal portion and declivity, the basal portion as long as the declivity, the former slightly convex, the latter feebly concave. Node of petiole very thick, distinctly narrower than the epinotum, the upper surface rounded and broad, anterior slope very convex, posterior slope flat and convex below, gaster short, from above subspherical.

Body finely punctured and opaque above; under surface of the body, legs, mandibles, and tip of gaster somewhat shining.

Hairs brownish, sparse, bristly and erect, scattered on the clypeus, dorsum of pronotum and metanotum, upper edge of the node of petiole and gaster; mandibles with fine and short hairs; grayish pubescence very fine, dense on the upper half of the body, including antennæ and legs.

Brownish black to deep reddish brown; antennæ and legs somewhat paler.

Female (deälated). Length 7.5 mm.

Resembling the worker and female of the typical form. Mesonotum flat above; epinotum more gibbous, the basal portion shorter than the declivity. Body black; mouth parts, antennæ and legs chestnut brown, and the flagellum and tarsus paler. Bristly hairs scanty; golden pubescence very dense on upper surface of thorax and abdomen, obscure on the head and legs.

Habitat. Prov. Hyûga (M. Yano); Prov. Buzen (M. Yano.); Tokyo (M. Oguma and M. Yano).

This subspecies differs from the typical *rufescens* in its darker color, more opaque surface, shorter pubescence, and in the shape of the epinotum which is more angular than in the European and North American forms of *rufescens.*

This ant is a rather common species near Tokyo and in Kiûiû, and probably throughout middle Japan. It inhabits nests in the earth in the most exposed situations and even in dry fields. The slaves of this ant are *Formica fusca fusca* var. *japonica* Motschulsky (=F. *fusca nipponensis* Forel), a common species in my country, and curiously seem to resemble it in general appearance. Their expeditions are made during the afternoon from the end of June to August, occasionally three times in the same day.

I wish to tender my sincere thanks to Prof. W. M. Wheeler for his valuable suggestions.

March 15, 1911.

ON *MELANETÆRIUS INFERNALIS* FALL.

By William Morton Wheeler,
Harvard University.

The singular Histerid beetle *Melanetærius infernalis* was first described by Fall in this journal in 1907[1] from a single individual taken at Pasadena, California, Dec. 1st, 1902, "from nest of unknown ant." While I was on a collecting trip during the past winter in Arizona and California Mr. Fall showed me the type specimen, which he had found in a collection obtained from a local entomologist who had died without leaving any information concerning the precise locality in which the beetle had been captured. By a strange coincidence, while I was collecting Dec. 1st, 1910, on the anniversary of the taking of this type specimen, I not only rediscovered the beetle but was able to ascertain the host-ant with which, in all probability, it normally lives. In a small canyon that enters the west side of the Gran Arroyo Seco near Pasadena, I found several nests of the typical yellow form of *Pheidole hyatti* Emery. All of these were under rather large stones, and from one of the nests, which was somewhat isolated and in the middle of the floor of the canyon, I took seven specimens of the *Melanetærius*. They were all quietly clinging to the under surface of the stone in the midst of the ants and made no effort to escape when the nest was disturbed. A few hundred yards from this spot and at the very opening of the side canyon into the Arroyo I found another colony of the same ant containing a single specimen of the beetle.

All of the specimens agree very closely with one another and with the type, so that there is nothing to add to Fall's excellent description. The accompanying figure shows the generic characters of *Melanetærius* as distinguished from those of *Hetærius*, viz. the absence of the elytral striæ and longitudinal thoracic grooves, the peculiar shape of the sides of the thorax, the remarkable legs with the elongate grooves at the dilated apices of the tibiæ for the accommodation of the reflexible tarsi, the remarkable folded hind tibiæ and the foveolate or coarsely punctate surface of much of the body.

---

[1] Two New Myrmecophilous Histeridæ. Psyche XIV, Aug. 1907, pp. 68–70.

The sides of the elytra bear stubby yellow hairs and the legs and tips of the median thoracic tubercles have pointed hairs of the same color. All these hairs are probably ant-alluring in function. It is, moreover, not improbable that the foveolæ are connected with exudate glands, but without a study of sections, this statement cannot be substantiated.

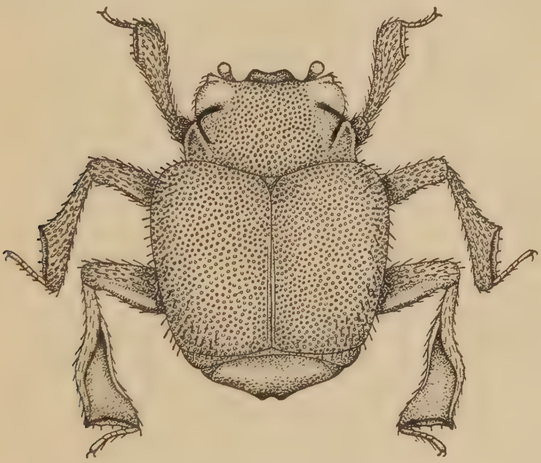

Fig. 1. *Melanetærius infernalis* Fall.

The typical form of *Pheidole hyatti* is very common in southern California, especially in the neighborhood of Pasadena, Claremont and Santa Barbara, where it nests in dry, open fields, usually under rather large stones but sometimes in obscure crater nests about the roots of plants in the chaparral. After finding the *Melanetærius* in two nests, I carefully searched all the *Pheidole* colonies which I encountered—several hundred in number—but the beetle was not again seen. It is certain, therefore, that it must be very rare and local. Since the various species of *Hetærius* occur only with species of *Formica* or very rarely (*H. minimus* Fall) with species of *Lasius*, the occurrence of *Melanetærius* in the colonies of a Myrmicine ant is additional evidence, if it were needed, that Fall was right in regarding this beetle as the type of a distinct genus and not as an aberrant species of *Hetærius*.

THE SOUND-MAKING OF DIPTERA AND HYMENOPTERA.

By C. E. Pemberton,
Stanford University, California.

That many Diptera and Hymenoptera produce sounds in two distinct ways has been an accepted belief for a long time. One of these ways is by the rapid vibration of the wings in the air; the other one is by the forcible inspiration and expiration of air through the spiracles, especially the thoracic ones.

The production of insect sounds by organs other than the wings was probably first noted by Aristotle when he said that the tracheæ were set in vibration by rapid in- and out-rushings of air causing a vibration somewhat similar to that produced by certain reed instruments.

Dr. H. Landois in 1867 in a very complete and exhaustive paper on the sounds and sound apparatus of insects devoted considerable attention to the Diptera and Hymenoptera. He made some elaborate explanations to prove that sounds were produced by certain vibratory portions of the spiracles, and performed a number of experiments to verify his explanations.

Burmeister also has advanced the theory that flies produced sounds by forcing air violently through the spiracles thus producing a vibration loud enough to be heard, and similar theories have been advanced by others. Landois's work however is still probably the standard.

Landois experimented with the house fly, (*Musca domestica*) a flower fly (*Eristalis tenax*), a dung fly (*Scatophaga stercoraria*), certain gnats, and a few other flies; also with a bumble bee, honey bee and certain wasps and hornets. With all he came to the same conclusion, namely, that besides the humming sound produced by the vibration of the wings in the air, another finer, higher-pitched sound was produced, not by the wings but by an apparatus connected with the spiracles and tracheæ, usually the thoracic spiracles only. He found that by stopping the openings of the spiracles humming ceases, or becomes so feeble as to be hardly perceptible.

In one family of flies, however, (Stratiomyidæ), in which the thoracic stigmata are not strongly developed, no humming sounds could be detected other than those produced by the wings. The stigmata were similar in structure to all others examined, but not so strongly developed.

It is interesting to note that Landois seems to find in those insects which hum loudest with their spiracles, the strongest developed spiracles to be found in all. These are, according to Landois, excellently developed for sound production. The external opening of the spiracle is covered with hairs and leads to an enlargement at the commencement of the trachea and immediately behind the spiracle. This enlargement serves as a sounding box. A folded membrane, called the vocal membrane and forming lips or curtains more or less plaited and fringed, is placed between the edges of the spiracle and the sounding box and, when vibrated by violent rushing of the air, produces sound. This theory has been carefully worked out by Landois and has been generally accepted as fact.

Having performed a number of experiments with certain Diptera and Hymenoptera, and having obtained results in exact contradiction to those of Landois, I venture to state these results, offering them to entomologists for what they are worth.

Despite the weight of testimony which seems to favor the theory of the spiracular voice, I cannot avoid the conclusion, from these observations of my own, that there has been some curious mistake about it all. My experiments with several species of Syrphidæ (*Eristalis tenax* in particular) the house fly, honey bee and the bumble bee, show that these insects do not produce audible sounds by vibration of any portion of their spiracles or tracheæ, but that all sounds of the nature of humming or buzzing produced by them are made solely by the wings, either by their vibration in the air or by striking the wing bases against the body wall.

In all the experiments I have kept constantly in mind Landois's theory and all my experiments have been performed in an attempt to verify it. However, not in a single instance have the results pointed in any way toward Landois's conclusions.

The following are the experiments and observations made on *Eristalis tenax*, similar ones with similar results having been made on several other Diptera and Hymenoptera.

Experiment I.

A fresh, living adult was held by the legs allowing free motion with the wings. Two sounds were produced, one low when the insect attempted to fly, and which was made simply by the vibration of the wings in the air, and the other about an octave higher, which was produced when the fly held the wings in a resting position and vibrated or trembled them very rapidly. This high-pitched note was made by the striking of the wing-bases against the body-wall immediately below and of the wing-bases. A proof for this was given when the wings were cut off close to the bases and the same pitch of note was sounded. A paper strip placed against the tips of the trembling wings so as to act as a sounder, increased the strength of the note which the wing-bases produced.

Experiment II.

The wings were cut off close to the body and the insect held by the legs as before. A loud, high-pitched buzz was produced. While producing the sound the wing-stubs were seen to be vibrating rapidly. Upon examining the spiracles while the sound was given, no external activity could be seen about them either in the hairs surrounding the opening or in the normal appearance of the spiracles while the insect was quiet. When a needle was placed against the vibrating wing-stubs the sound always ceased. By cementing the wing-stubs to the body no sound was made, though the spiracles were open and untouched.

Thus if the fly produces this high-pitched note by means of the spiracles it must be done only when the wings or wing muscles are free to act.

Experiment III.

To prove that the spiracles have nothing to do with this note and that they are not needed in connection with the wing muscles in the sound production, the abdomen was cut off, likewise the head, and the thoracic spiracles securely cemented with collodion. Under these conditions the free wing-stubs still vibrated a little and produced the familiar buzz for a short time. By leaving the head intact in this experiment the note was as strong and clear as in a fresh uninjured specimen. A fresh fly with all spiracles securely closed and wings cut off, can be made to produce the loud hum and stop at will by holding or releasing the wing-stubs with a needle.

In another case the thoracic spiracles were completely destroyed with a needle, and the abdomen cut off, but the wings left free. The usual high-pitched buzz or hum was still produced.

Now, combining the fact that no sound, in any single case, was produced with spiracles open and wings secured from action, with the fact that sound, high and clear, was produced in every case with wings cut off or intact, but free at the base, even though all the spiracles were securely closed, we have, it seems to me, positive proof as to the cause of all the audible sounds produced by this fly.

A further experiment was made which verifies in a way what has already been proved.

The wings were pulled from an adult in such a manner as to remove them completely, leaving no traces of the bases. No sounds were produced. Landois believed to have done this, but seems only to have cut the wings off as closely as possible. It would be impossible to cut off the wings without leaving some very small portion which would be large enough to vibrate and produce a sound.

The above experiments were carefully repeated several times with the same results in every case. They seem to prove quite conclusively that the supposed sound of the spiracles is merely a buzzing of the wing-bases or a striking of them against a portion of the body-wall adjoining them. The well-adapted character of the spiracles for the production of sound if air could be very violently forced through them, combined with the confusing fact that the same pitch of sound is produced both with the wings cut off and intact, might easily lead one to conclude that the sounds were produced by some other organ than the wings.

The question may well be asked, "Why are the spiracles so modified and complex as Landois considers them?" It must be taken into consideration that the spiracles are comparatively large openings to a very delicate and vital tracheal system, which should be safely guarded at its openings against the entrance of dust particles. In most cases they are protected by a dense growth of hairs but often are not, as for example in the honey bee. The thoracic spiracles of the honey bee are poorly protected externally but within the opening this folded membranous curtain, or so-called vocal membrane, acts undoubtedly as a screen against the entrance of dust, etc.

The work described in this paper was done in the Entomological Laboratory of Stanford University.

THE STRIDULATIONS OF TWO INTERESTING LOCUSTIDÆ.[1]

By H. A. Allard,

U. S. Department of Agriculture, Washington, D. C.

The writer's first night collecting on Plummer's Island, near Washington, D. C., August 25, 1909, made him acquainted, for the first time, with the stridulation of *Atlanticus pachymerus* Burmeister. It was singing after dark very close to the ground on a dry, rocky, thinly-wooded hillside. The notes of this odd-looking locust have the same lisping character as an Orchelimum. The phrases are brief, but rapidly repeated, with irregular intervals of silence intervening, sh-sh-sh-sh-sh—sh-sh-sh-sh—sh-sh-sh-sh-sh. One is reminded of the prolonged, lisping phrases of *Orchelimum molossum* Rehn. Several times, while watching the insect stridulate by lantern-light, the writer lisped an approach to its notes and got an immediate response. The grayish brown coloration of this locust is well adapted to its environment of dead leaves and vegetation. The tegmina are very short, giving the insect an awkard, unfinished appearance.

---

[1] Identified by Mr. A. N. Caudell of the U. S. National Museum.

Pyrgocorypha uncinata Harris. In October, 1909, the writer took a single female of this interesting locust at Thompson's Mills, Northern Georgia. This individual had entered a dwelling and was crawling on the wall, probably attracted by a lighted lamp. No other individuals were taken until the writer captured a single male in stridulation in the same locality one dark night in October, 1910. The insect was traced by its note to the low grass and weeds on a bank almost in the midst of the settlement. By the strong light of a bull's eye lantern the writer approached within a foot or two of the insect which continued to stridulate vigorously for some time, even though in the full glare of a strong light. After its notes had ceased, the insect at intervals jerked its body and wings spasmodically without producing any sound. This peculiar behavior is characteristic of a number of species of Conocephalus when disturbed during stridulation.

As Mr. A. N. Caudell has pointed out, it is probable that the male taken in Northern Georgia had not arrived at the adult stage very long before its capture, since its tissues, which must have been soft, had shrunken considerably after mounting and drying. On the grass and weeds very near where this male was taken, the writer a night or two before heard several locusts in stridulation, presumably individuals of *Pyrgocorypha uncinata*. As these insects were heard in stridulation but one or two nights, it is possible that the stridulation period of this Pyrgocrypha is very brief. The stridulation of this locust is a loud, penetrating, prolonged z-z-z-z-z-z-z-z-z-z-z-z-z-z quite like the notes of a Conocephalus. Its habits in many ways are very similar to those of a Conocephalus which it resembles in some respects.

Previous to the writer's observations in Northern Georgia, the stridulations of *Pyrgocorypha uncinata* appear to have been unknown.

December, 1910.

ANOTHER AQUATIC CATERPILLAR (*ELOPHILA*).

By Wm. T. M. Forbes,
New Brunswick, N. J.

In my paper in the December Psyche, I referred to Elophila (*Cataclysta*) as a larva not yet known in America. There is a cocoon of this genus in the College collection here, agreeing with those of the European species. It contained a skin in exceptionally good condition, making it possible to compare the caterpillar as well as the chrysalis with those of Nymphula and Paraponyx.

Caterpillar. In general characters agreeing with that of the other two aquatic genera; with smallish head, no tracheal gills, no posterior ocellus; with head, setæ and prolegs essentially as in Nymphula. Punctures of front closer together than in the others (¼ as far apart as the setæ) adfrontal punctures higher than setæ, but not so much; *i* of labrum (see figure) much lower than *ii* and quite near the middle line; the puncture near *ii*; antennæ as in Nymphula proper, but the first seta is rather farther out. Lower lip normal. Apparently there are only three ocelli, but the specimen is not favorable. Prolegs as in Nymphula proper, the ventrals with 50, the anals with 15 hooks. Spiracles of first four abdominal segments larger, especially those of A3 and 4; but the others are more than half as large, and evidently functional.

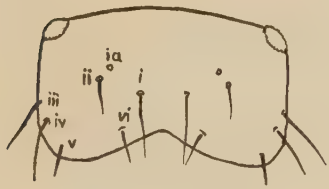

Fig. 1. Labrum of *Elophila* sp.

Case spheroidal, of a mosaic of Lemna leaves. It is distinguished from those of Nymphula and Hydrocampa by the lack of a sharp lateral edge. The leaves of the case do not seem to be eaten.

Pupa similar in appearance to Nymphula, and in details except as follows. The last spiracles are on little conical projections, and where the spiracle of A9 should be there is a more prominent irregularly conical spine. Of the three enlarged spiracles, the first is but little smaller. There are two parallel thickened transverse ridges on the center of the seventh and eighth abdominal segments, just beyond the trip of the leg-case. They may be an abnormality.

The species is only half as large as an average Nymphula.

Specimen from Cedar Lake, in the northwest corner of New Jersey. This genus is evidently much nearer to Nymphula (Hydrocampa) than to Paraponyx, but may be easily distinguished by the different case and different front and labrum of the larva; and by the very small size of the pupa (perhaps also by the ridges on the under side of the abdomen.)

A FEW SUGGESTIONS ON THE CARE OF THE EGGS AND THE REARING OF THE WALKING-STICK, *DIAPHEROMERA FEMORATA* SAY.

By Henry H. P. Severin, College of Hawaii, and
Harry C. Severin, South Dakota State College.

Some difficulty seems to have been experienced by a number of investigators to determine the number of molts which various species of Phasmids have. In a previous paper (7) we discussed the diversity of opinions of various entomologists concerning the number of molts undergone by our common American walking-stick, *Diapheromera femorata*. Among the European Phasmidae, *Bacillus rossii* seems to offer the greatest opportunity for a difference in opinion as to the probable number of molts. According to Pagenstecher,[1] *Bacillus rossii* casts its skin seven or eight times, while Kheil (4) and Godelmann (3) both agree upon five molts. Daiber (2), who did some work on this same species of walking-stick, is unable to give the number of molts with certainty, because as she explains, the process of ecdysis occurs during the night and the exuviated skins are often eaten immediately by the recently molted walking-sticks. She says, "Da aus den angeführten Gründen mit Leichtigkeit eine Häutung übersehen werden kann, möchte ich diese Zahl von 5 Häutungen als Minimum bezeichnen." v. Baehr (1) "möchte auch behaupten, dass die Zahl 5 zu klein ist."

---

[1] Paper not accessible. Quoted from Godelmann's (3) paper.

In the above-mentioned paper we (7) called attention also to certain indications which appear a day or two before Diapheromera molts. A method, which instantly revealed to us when the walking-stick had molted, was to first mark them with a toothpick, match or needle dipped in water-proof India ink. A few hours after each molt, some difficulty may be experienced in marking the specimens, for the ink may not then spread evenly but may run together to form drops, as if the newly exposed integument was oily. This may be due to the molting or exuvial fluid which forms between the old and new skins at the time of ecdysis. If, however, the integument has thoroughly dried, no trouble will be encountered in marking the walking-sticks. Sometimes after a week or more, the India ink will wear or peel off, but this can be replaced very readily by a second coating.

In our experiments, the walking-sticks were reared to maturity in a large glass jar covered with a glass plate. Five young walking-sticks were usually placed in each jar, these insects being first marked with India ink on the dorsal side of one of the three divisions of the thorax or the anterior or posterior halves of the abdomen. At the bottom of the jar rested a small narrow-mouthed bottle filled with water, in which had been placed a few twigs of hazel-nut or linden leaves. If a wide-mouthed bottle was used, the top was closed around the twigs, for the young walking-sticks in wandering about, as well as during the process of molting, will otherwise often fall into the water and drown. The water in the bottles was either changed every day or the loss of water from the bottles due to evaporation or to transpiration of the leaves was replaced with fresh water through a long pipette. All the leaves attacked by fungus or bacterial diseases were removed from the twigs; and the jar as well as the leaves were freed daily from all excrement. Fresh twigs of hazel-nut or linden leaves, first carefully washed in water, were supplied about twice a week. The moisture which condensed in the jar was removed whenever drops were formed, especial care in this respect being exercised when the walking-sticks were very young, for otherwise many specimens were found sticking to the glass jar. By keeping the jars away from open windows, the condensation of the water was greatly reduced.

To hatch the leaf-insect, *Phyllium scythe* (Gray), Morton (5) placed the eggs, "sur du sable fin dans une boîte couverte par une feuille de papier buvard épais. La boîte fut mise dans une cage en treillis, dans une serre, dont la température normal varie entre 18 et 20° C., et le papier buvard humecté chaque jour, afin de donner aux œufs, sans les mouiller, une certaine humidité." Other naturalists, who hatched the eggs of various species of Phasmids, used a wet sponge to supply the eggs with moisture. In our work with Diapheromera, the eggs were kept upon fine lake sand which was sprayed with water whenever it became too dry. Attention has already been called in a previous paper (6) to the fact, that if the sand is kept too dry, especially at the time of hatching, many walking-sticks fail to emerge completely from the eggs. If the eggs are kept in a well aërated breeding cage, molding can be prevented.

BIBLIOGRAPHY.

1. v. Baehr, W. B., 1907. Uber die Zahl der Richtungskörper in parthenogentisch sich entwickelnden Eiern von Bacillus rossii. Zoöl. Jahrb. Anat. XXIV, pp. 175–191.
2. Daiber, M., 1905. Beiträge zur Kenntniss der Ovarien von Bacillus rossii Fabr. nebst einigen biologischen Bemerkungen. Jena Zeit. f. Naturw. XXXIX, pp. 177–202.
3. Godelmann, R., 1901. Beiträge zur Kenntnis von Bacillus rossii Fabr. mit besonderer Berücksichtigung der bei ihm vorkommenden Autotomie und Regeneration einzelner Gliedmassen. Arch. Entmech. XII, pp. 265–301.
4. Kheil, N., 1900. Biologisches über Bacillus rossii. Ent. Zeit. No. 16 u.17.
5. Morton, W., 1903. Notes sur l'élevage des Phyllies. Bull. Soc. Vaud. Sci. Nat. XXXIX, pp. 401–7.
6. Severin, H. H. P. and Severin, H. C., 1910. The Effect of Moisture and Dryness on the Emergence from the Egg of the Walking-stick, Diapheromera femorata Say. Jour. Econ. Ent. III, No. 6. pp. 479–481.
7. ———— 1911. The Life-History of the Walking-stick, Diapheromera femorata Say. Ibid. IV, No. 3.

At the regular meeting of the Cambridge Entomological Club on June 20, 1911, the following resolution was adopted:

Whereas, by the death of Samuel Hubbard Scudder on May 17, 1911, the Cambridge Entomological Club has suffered a great loss which will be shared by entomologists the world over, and

Whereas, Dr. Scudder was one of the founders of the Club, and during its early days, a leader in all of its activities, and

Whereas, under his guidance, the publication of Psyche was begun nearly forty years ago, be it

Resolved, that in recognition not only of our own debt to him, but of his eminence in the scientific world, the club publish as the last issue of the present volume of Psyche, a number which will be a small tribute to the memory of one who, by incessant labors, added so greatly to our knowledge of both living and fossil insects.
